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PLANETARY VEHICLE THERMAL

INSULATION SYSTEMS

MONTHLY PROGRESS REPORT NO. 7

FOR THE PERIOD

3 APRIL 1967 TO 7 MAY 1967

SUBMITTED BY:

General Electric Company
Spacecraft Department
Valley Forge Space Technology Center
P.O. Box 8555 - Philadelphia, Pa. 19101

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Program Manager, PVTIS

PLANETARY VEHICLE THERMAL INSULATION SYSTEMS

Monthly Progress Report for the period 3 April 1967 to 7 May 1967.

1.0 SUMMARY

The full scale thermal test model design has been completed and insulation system design is underway.

Test levels for environmental and the long duration vacuum test vibration run have been finalized. A liquid motor has been selected as a basis for the latter test.

A support post has been designed and is currently in the process of evaluation.

Vapor deposited gold Mylar and Kapton have been selected as the primary insulation materials. Evaluation and vendor selection is currently underway.

2.0 MAJOR ACCOMPLISHMENTS

2.1 Design Engineering

The full scale test fixture design has been completed, and is ready for fabrication. Insulation design is proceeding. The step or rabbit joint has been selected for further evaluation, and a unique fastener is being investigated for insulation attachment. Plans have been completed for a second series of depressurization tests.

2.2 Thermal Engineering

Detailed thermal analyses for the capsule have been completed, and the spacecraft analyses are nearly complete.

2.3 Test Engineering

The random vibration and acoustic test requirements have been reviewed and changes to the test spectrum have been submitted for approval.

Vibration requirements for the long term vacuum test have been reviewed along with data on start/stop transients and changes to the test spectrum have been submitted for approval. The liquid motor has the more severe environment and will be used as the basis of simulation.

2.4 Manufacturing Engineering

It has been demonstrated that Mylar metallized on one side will curl along the edges when subjected to heat sterilization. Kapton metallized on one side and Mylar metallized on both sides do not curl under similar conditions.

A sample support post ("Tinger") has been fabricated.

2.5 Insulation Material Status

A decision to use single sided vapor deposited gold on Mylar, and eliminate heat sterilization has been made. Gold on Kapton will be used exclusively on the engine facing side of the spacecraft. Currently, work is proceeding with several vendors to obtain sources for delivery of acceptable insulation materials.

The elimination of heat sterilization will cancel the requirement for subjecting one of the environmental test blankets to a single cycle of ETO and heat prior to the first set of shock, vibration, and acoustic tests.

3.0 MAJOR PROBLEMS

The major remaining problem with vapor deposited gold on Mylar is the improvement of adherence. Preliminary tests have indicated that application of heat will result in acceptable adherence. Additional tests will be performed with rolls to evolve a method of curing production quantities. Evaluation of vapor deposited gold on Kapton is currently being performed.

4.0 OBJECTIVES FOR MAY

4.1 Complete the spacecraft thermal analysis

4.2 Complete Phase IV data acquisition and analysis procedures

4.3 Finalize plans and select insulation vendors for vapor deposited gold on Mylar and Kapton

4.4 Check-out exciter fixture for long term vacuum test

4.5 Continue insulation blanket design

5.0 TECHNICAL STATUS

5.1 Design Engineering

The full scale model structural design has been completed and drawings have been issued for approval by JPL. Insulation drawings for the model are in process. The final design work, which has been started and which will be completed late in the next reporting period is the installations design; i.e., heaters, thermocouples, etc.

The second depressurization test has been planned. Objectives have been stated, blanket and joint concepts outlined and an evaluation format completed. One eighth diameter vent holes will be the size used with variations in the number of holes as the criteria for evaluation.

The step or rabbet joint has been selected as the design to be used in blanket evaluations. This joint will use fasteners which are assembled to the blanket so that the blanket need not be removed from the fasteners, thereby eliminating much potential handling damage. These fasteners will attach to the vehicle outer shell by means of "Velcro - hook and pile". Fasteners will be staggered so that there will be approximately one fastener per foot of joint and tape will be used between fasteners to prevent opening of the joint.

5.2 Test Engineering

Based upon information supplied by TRW on the LEMDE engine and Aerojet-General for a modified Minuteman solid motor, it has been decided to base the vibration test after long term vacuum exposure on the liquid engine PSD spectrum. This is

definetly the more severe environment. Analysis also indicates that the high frequency portion of the PSD test spectrum will adequately simulate the peak loads incurred during the orbit, insertion engines start/stop transients.

5.3 Manufacturing Engineering

It has been demonstrated that if single sided metallized Mylar is subjected to heat sterilization, the edges will curl. Kapton metallized on one side or Mylar metallized on both sides does not show any curling tendency after being heat sterilized (275°F) for over 100 hours. These tests were conducted with gold and aluminum coated Mylar and Kapton.

Methods to crinkle and perforate the material for use in making insulation blankets have been developed. Tooling has been designed for crinkling and lay-up. The design of the tools for perforating will begin after the hole pattern is determined by the decompression tests.

A sample support post for insulation blankets was fabricated ("Tinger"). It was constructed of nylon with pressure sensitive velcro tape mounted on the base. The holding force was great enough to bend the post before releasing. If the "Tinger" is used for mounting the blankets on the test fixture, approximately 3,000 will be required.

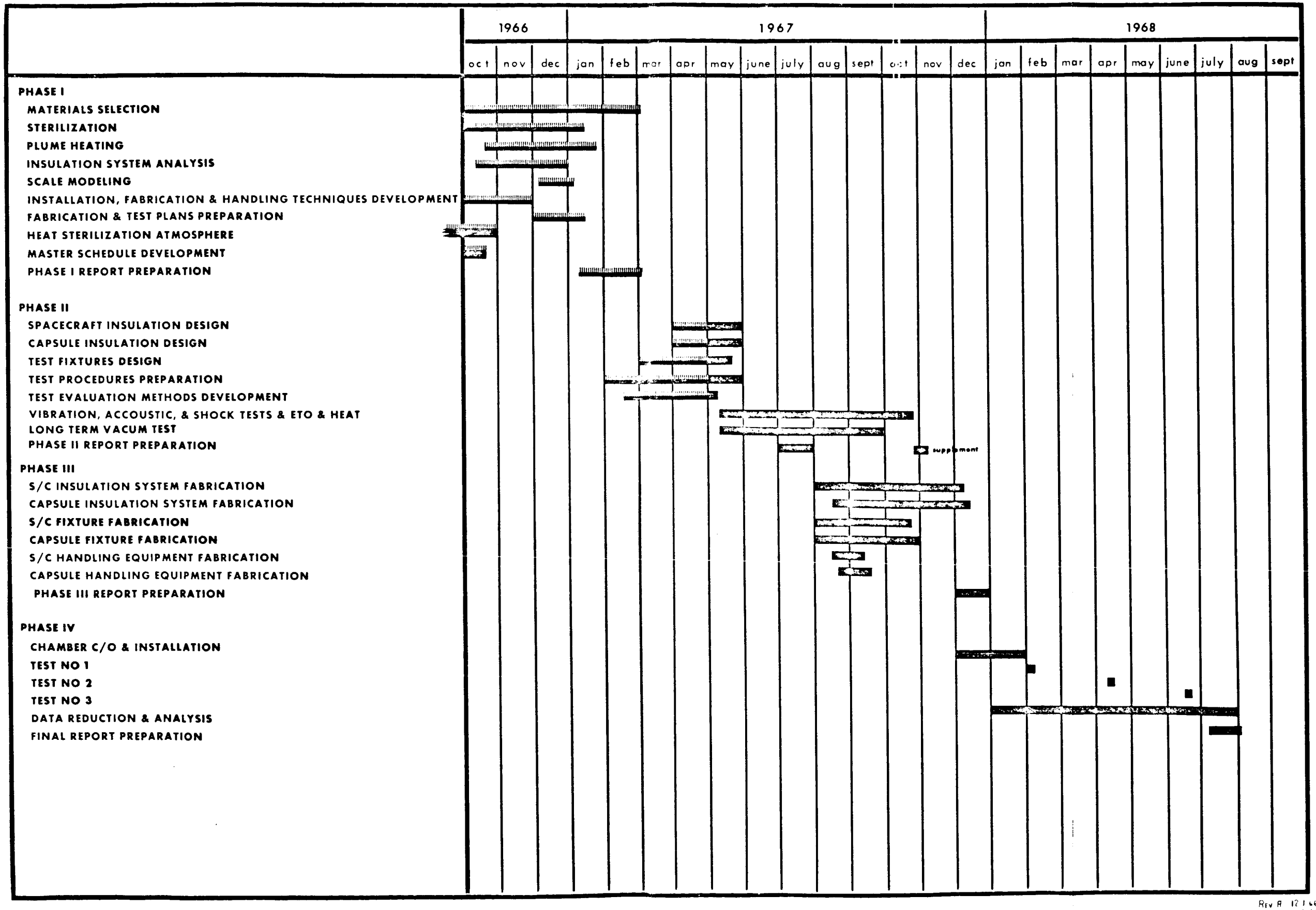
5.4 Insulation Material Status

The insulation systems for this program are to be used exclusively on the spacecraft and on the capsule external to the biological barrier. As such, the need for heat sterilization is eliminated. Vapor deposited gold on Mylar, single sided, will be satisfactory, since edge curling and shrinkage will not occur. Vapor deposited gold on Kapton on the engine end of the spacecraft

will withstand the effects of engine heating.

The adherence of gold to Mylar needs to be improved. Work performed by General Electric indicates that satisfactory adherence can be obtained by heating after deposition. Additional verification tests are underway. Evaluation of vapor deposited gold on Kapton is currently underway.

PLANETARY VEHICLE
THERMAL INSULATION PROGRAM



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Rev B 1-5-67
Rev C 3-24-67
Rev D 5-5-67

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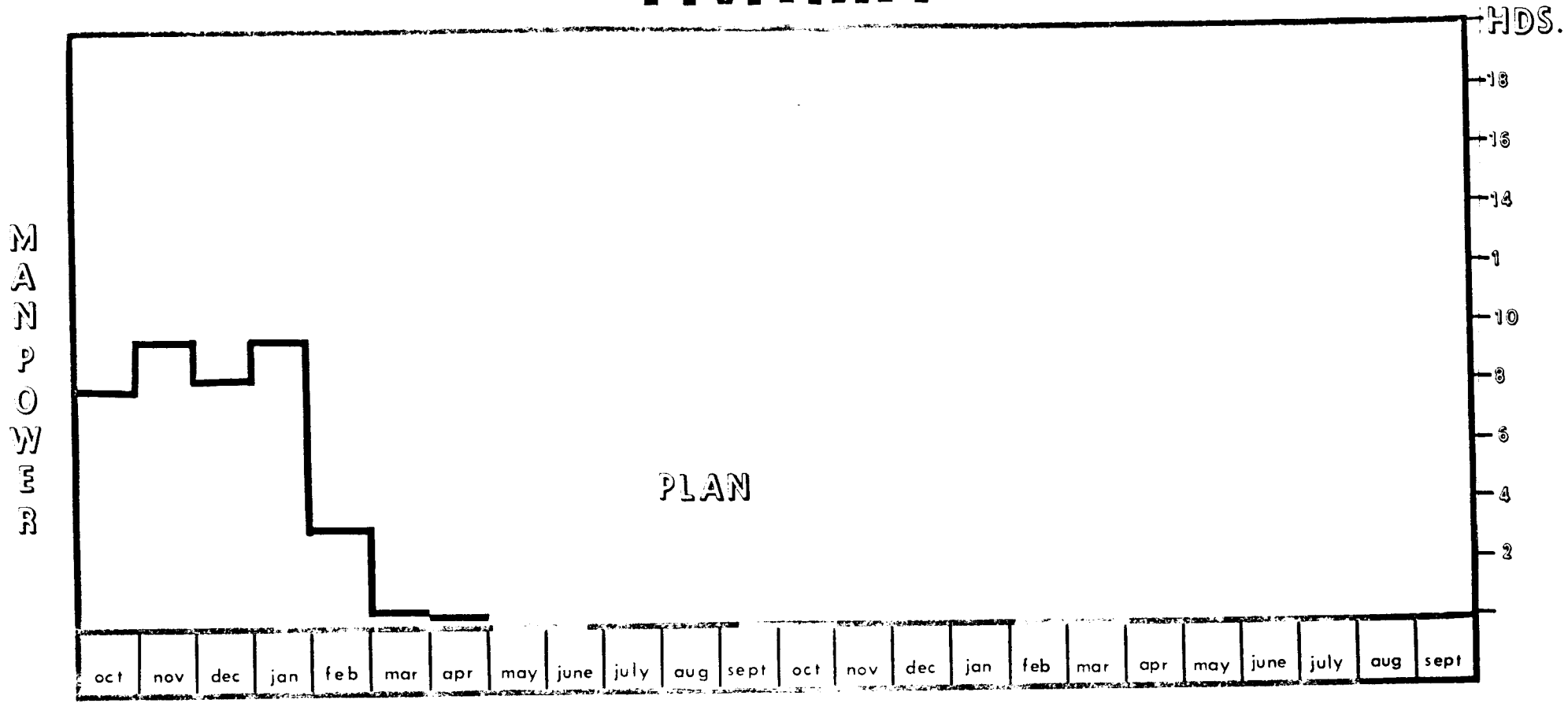
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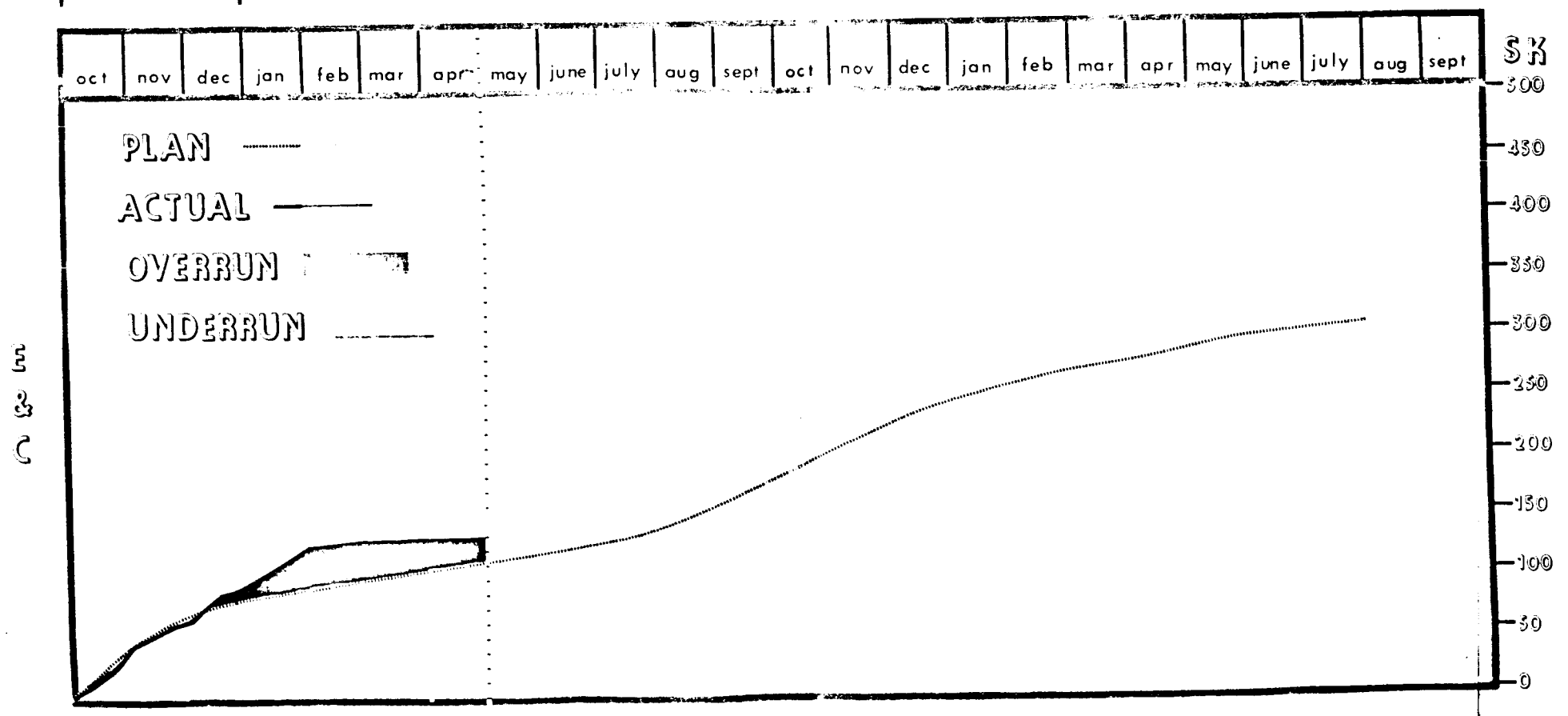
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